The Earth Science DIGEST

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1950

THE EARTH SCIENCE INSTITUTE

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Contents

GROUND SLOTH DISCOVERED IN NEW JERSEY

PHILADELPHIA, Nov. 22 — Discovery of fossil remains of the extinct Ground Sloth which roamed parts of North America a hundred thousand years ago was announced today by the Academy of Natural Sciences of Philadelphia.

Dr. Horace G. Richards, Associate Curator of Geology and Paleontology, is responsible for the discovery of parts of the vertebra which prove the existence of this great fifteen foot bear-like mammal near what is now Moorestown, N. J. The bones were unearthed in an excavation for the New Jersey Turnpike.

In the interest of the Academy's geological work, Dr. Richards has been following the excavations for this turnpike, greatly aided by observers acting at his direction. James Ruhle, age 14, of Church Road, Moorestown, was the lucky watcher who reported the uncovering of these bones to Dr. Richards.

The animal, **Megalonyx jeffersonii,** was probably about fifteen feet in length and is related to present-day sloths of South America. It is known to have lived in North America during certain stages of the Pleistocene Period when the climate was a little warmer than at present. Although this species has never been reported previously from New Jersey, its presence in the Pleistocene gravels near Moorestown is entirely logical, Dr. Richards states.

This discovery is the first record of **Megalonyx** from New Jersey, although a number of bones of this same species of Ground Sloth were found many years ago in a cave at Port Kennedy, Pa., on the Schuylkill River, and fragments of a related sloth were found near Long Branch, N. J. in 1883.

The finding of the **Megalonyx** Ground Sloth near Philadelphia is especially interesting. In 1797, Thomas Jefferson read a paper before the American Philosophical Society in Philadelphia describing what he thought were the bones of a giant tiger, obtained from a cave in Virginia (now part of West Virginia). To these specimens he assigned the name **Megalonyx,** meaning great claw. A few years later, Dr. Casper Wistar, the famous Philadelphia anatomist, restudied the bones and discovered their true relationship — to the South American sloths. In spite of the error in identification, Jefferson's work was noteworthy as being one of the first contributions to the study of fossils in North America. The name, **Megalonyx** which he designated, even with its incorrect meaning, is still used for this animal. These specimens of Thomas Jefferson's are in the Academy's collections, deposited by the American Philosophical Society.

Another interesting point about the New Jersey discovery is that the first dinosaur to be found in the United States was uncovered there by the Academy in 1858. This was near Haddonfield, N. J. In 1947, the Academy, with Dr. Richards again as field representative, discovered the remains of another Hadrosaurus, this time near Sewell, N. J.

In addition to holding his post in the Academy, Dr. Richards is a lecturer in the University of Pennsylvania, and a member of the Advisory Board of the Earth Science Digest.

Potholes and Channel Scrolls in the Navajo Sandstone, Zion National Park, Utah

ROGER L. SPITZNAS

Fig. 1. Checkerboard Mesa, Zion National Park, showing extensive cross-bedding and jointing within the Navajo sandstone. Photo by Roger L. Spitznas.

Along the streams in the upper reaches of Zion National Park, Utah, occur erosional features of unusual interest. Represented are potholes and intrenched channel scrolls. The potholes though less typically shaped than those in more durable rocks are present along some of the streams. Even more common and more pronounced in their development are semi-circular borings which notch and scar the steep sandstone walls along the ephemeral streams. Typical development of the two erosional features may be seen in the channel of Pine and Clear Creeks and in many streams tributary to these creeks.

The most extensively outcropping rock formation within the park is the Navajo sandstone, typified by its red and white coloring and its massive, delicate, yet intricate cross-bedding. The 2,000 foot thick formation is red-brown

Fig. 2. Two small potholes along the channel of Pine Creek in Zion National Park. Note removal of the wall and downward expansion of the righthand pothole. Photo by Roger L. Spitznas.

near the base and is sparkling white near the top. In the intermediate areas the reds and white combine into variegated shadings. In composition the Navajo is dominantly a quartz sandstone of nearly equal proportions of fine and coarse grains. The white portions of the formation reflect the crystal-clear quartz grains while other colors result from iron compounds which surround grains and cement them together. Within the formation are two sets of pronounced joints which trend approximately 13° west of north and 80° east of north. These intersecting joints strongly control the topography of the park which is typified by large and small canyons whose walls are steeply inclined or vertical. In fact, in some places even overhangs occur.

Climate and vegetation favor deep, rapid erosion of the weakly cemented sandstone. Trees and shrubs are common in the larger canyons and along the more moist plateau top, but little vegetation is present on the precipitous canyon walls. Precipitation for

Fig. 3. View of a section of scrolling that has been active. The etched oblique lines show the cross-bedding in the sandstone, and the arcuate scars along the wall are remnants of past scrolling. Photo by Roger L. Spitznas.

the year is distributed in two wet and two dry seasons and totals 10 to 20 inches. Torrential summer showers infrequently deliver one to two inches. Runoff in the ephemeral streams is torrential as little vegetation is present to catch and hold the water.

In channels of streams in the high lands where youthful streams are strongly joint controlled and where gradients are high, the resulting stream erosion assumes the type here called scrolling. The rapidly flowing water impinges on one wall of the 'canyonlet' and is sharply deflected against the opposite wall where the deflection is reversed, the water striking the original diverting wall at a point down stream from the original point of contact. The distance between two successive points of

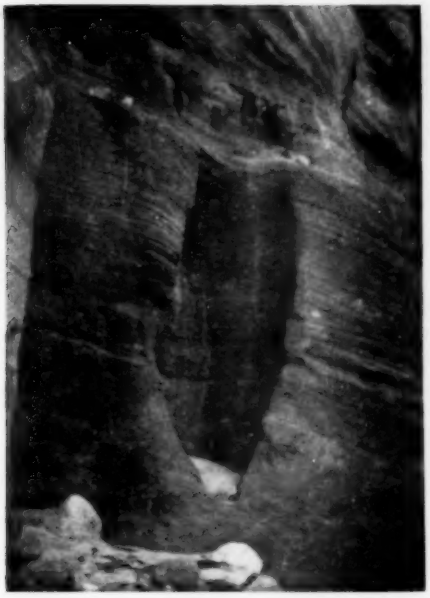

Fig. 4. A high, abandoned scroll with a pothole-like bottom. Size, about 15 feet high by 3 feet wide. Photo by Roger L. Spitznas.

Fig. 5. A channeling section approximately 10 feet wide and sixty feet deep accomplished by scrolling. The semi-circular scars are old scrolls. Photo by Roger L. Spitznas.

contact along one wall depends upon the angle through which the deflection takes place and the radius of action in the separate scrolls. Pothole erosion is favored by lower channel gradients which in turn favor eddying of the water and spiral vortex currents. In local channel sections of low gradient potholes have been ground into the sandstone bedrock. The size and shape of the potholes is controlled by the radius of action of centrifugal and centripetal forces and the relative durability of the bedrock. Differential cementing and cross-bedding in the sandstone allow asymmetrical development more extensively than is the case in more durable and more homogeneous bedrock types. The smaller potholes show less asymmetry due to the minimum effect the bedrock variations have had on their development.

Local channel gradients in excess of 150-200 feet per mile seem to favor the scroll type erosion while gradients below these values seem to favor potholes erosion in this area. The two types of channel corrosion thus seem to be related, the resultant type being dependent upon local channel conditions. In all areas of scroll development the channel is narrow, deep, and of high gradient. Potholes are found only where the channel is broad and of relatively lower gradient. That some erosion of the pothole type occurs at the base of the water current in the scrolls can not be denied; for high, abandoned scrolls have bottoms which are typical of spiral vortex current action. The formation of spiral vortex currents below the main water mass swinging in its semi-circular path through the scroll results from internal friction

in the water and friction of the water along the bedrock. The close relationship of the two erosion types suggests that one type may give way to the other along a single stream as favorable conditions vary along the channel. Both types of bedrock corrasion are effective in breaching and leveling inequalities of slope along the streams. Potholes act to remove the less precipitous irregularities in broad channel sections, and scrolling works to eliminate the more pronounced irregularities in narrow, constricted channel sections.

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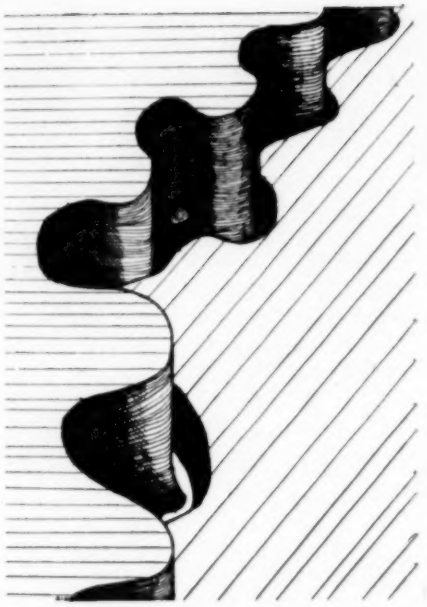

Fig. 6. Generalized and idealized sketch from photos and field sketches showing the interlocking of spurs in an area of scroll type erosion.

GEOLOGISTS FIND SUNKEN BARGE IN CHESAPEAKE BAY

WASHINGTON, Dec. 21—Geophysicists of the U. S. Geological Survey, using an airborne electronic device, have found sunken treasure at the bottom of Chesapeake Bay, it was disclosed today.

The treasure consisted not of a Spanish galleon filled with gold but of a barge loaded with steel beams specially fabricated for use on the new Chesapeake Bay Bridge.

The barge was one of three which broke loose from their moorings near the bridge construction site, north of Annapolis, Maryland, during the severe storm early in December. Two were readily found about 10 miles up the Bay, but the third disappeared completely and was believed sunk.

Engineers of the bridge contractors, the Frederick Snare Company, New York City, sought to start an underwater search for the missing barge, which, if sunk in the Bay's main ship or ferry channels, might be a hazard to navigation. The engineers consulted firms on both the Atlantic and Pacific coast specializing in submarine location work. None held out any hope for quick success.

The engineers next conferred with James E. Bacon, Washington, D. C., technical consultant, who suggested that the search be conducted with an airborne magnetometer — an instrument of the type developed during World War II for locating submerged enemy submarines.

When Mr. Bacon found that private firms were unable to undertake the job, he appealed to the Department of Interior's Geological Survey. Survey

geophysicists were making an aeromagnetic survey in eastern Maryland and in view of the unusual circumstances, Survey Director William E. Wrather authorized James Balsley, in charge of the research project, to lend a hand.

After plotting a series of traverses over a five-mile-wide section of the Bay, spaced 500 feet apart, the scientists took off in a Survey airplane with a magnetometer dangling below the plane's belly. On the 10th traverse, the instrument registered a strong change in magnetic strength at considerable depth, in one particular spot.

To communicate with a small boat owned by the contractors, in order to mark the location with a buoy, the scientists called the tower at Washington National Airport, where messages were relayed by telephone to Sandy Point, Maryland, and from there to the boat by shore-to-ship radio-telephone.

A salvage tug was later dispatched to the scene and divers were sent down to verify the magnetometer findings. The divers located the missing barge on December 16. The work of hoisting the steel beams to the surface began this week.

AGREEMENT CONCLUDED ON PRODUCTION OF URANIUM FROM SOUTH AFRICAN GOLD ORE

WASHINGTON, Dec. 14 — Uranium to be produced in the Union of South Africa as a by-product of gold production will be sold to the United States and the United Kingdom under an agreement just concluded by the three nations.

The new agreement marks the successful culmination of several years of intensive research and development by the three nations on the problem of economically recovering uranium from the gold-bearing ores.

The South African gold ores represent one of the world's largest sources of uranium. Although the uranium content of the ores is small, potential production is relatively large because of the great quantities of ore mined.

The initial production will come from the properties of the following mining companies, although consideration will be given by South African Government to the construction of additional uranium processing plants on other mine properties as it is warranted:

1. West Rand Consolidated Mines, Ltd.
2. Daggafontein Mines, Ltd.
3. Blyvooruitzicht Gold Mining Co., Ltd.
4. Western Reefs Exploration and Development Co., Ltd.

Funds to cover the capital cost of the uranium processing plants will be loaned by the United States and United Kingdom, on a banking basis, if requested by the South Africans.

Although uranium will be a valuable by-product of gold production, the revenue and earnings from uranium will not be on such a scale as to affect materially the financial positions of the companies concerned.

Negotiations which led to the new agreement were concluded last month in Johannesburg by representatives of the three nations. Preliminary discussions were held in the same city a year ago. The principal representative of the United States at the meeting last month was Mr. Jesse C. Johnson, Manager of the Raw Materials Operations Office of the U. S. Atomic Energy Commission.

Plant design and construction leading to the production of uranium under the new agreement is proceeding on an urgent basis. Because of security considerations, no information on rate of progress or other aspects of the program can be made public.

THE ORIGIN OF SEA-WATER

HERBERT B. NICHOLS
U. S. Geological Survey

Gases escaping to the atmosphere from the earth's interior mostly through hot springs have been suggested by William W. Rubey of the U. S. Geological Survey as accounting for both the ocean's gradually increasing volume and the fact that our planet's gaseous envelope is being replenished constantly.

Delivering his address as retiring president of the Geological Society of America at its 63rd annual meeting, he asserted that while this thought is not entirely new, it deserves greater consideration by scientists than has been accorded formerly. Although the composition of sea-water and atmosphere has probably changed somewhat through the earth's geologic past, there is much evidence of a biological nature and in the mineral content of sedimentary rocks to show that on the whole such changes have been relatively slight.

A primary problem is to determine how conditions could have remained so nearly constant for so long a time. Mr. Rubey became interested in changes in the composition of sea-water following a number of field seasons spent in mapping the Phosphoria formation in Western Wyoming.

This geologic horizon contains rich beds of phosphate, mined for use in commercial fertilizer. He thought it interesting to examine in the light of modern oceanographical concepts, the possibility that such vast deposits might have been laid down by direct chemical of biochemical precipitation from sea-water.

Starting with salinities of sea-water and a carbon dioxide content of the atmosphere the same as those of today, he hoped to find the combination of circumstances most favorable to deposition and preservation of the minerals common in that particular formation. The approach led to interesting and rather reasonable-sounding conclusions.

But as this study progressed he became increasingly dissatisfied with his initial arbitrary assumption that the salinities of sea-water and the carbon dioxide content of the atmosphere were approximately the same 200,000,000 years ago (during the Permian Period) as they are today.

As a result he began searching for alternative assumptions on which to estimate the composition of sea-water and atmosphere in Phosphoria time. It soon became evident that relatively slight changes in these compositions might have surprisingly large effects on the processes and environment that operated on organisms and sediments even far outside the limits of the Phosphoria sea.

Thus what started out to be a minor sub-head in a brief paper on phosphate deposition grew into a full-fledged study with many by-paths. To mention a few:

1. The effects of possible chemical changes in sea-water upon marine organisms.

2. The composition and quantity of deep-sea sediments today and in the past.
3. The relative importance of juvenile (new), resurgent (renewed), and vadose underground) waters in volcanic activity and magmatic processes.
4. The origin of continents and the permanence of ocean basins.

A review of previous discussions on the composition of sea-water in the past, disclosed four trends of thought to Mr. Rubey:

a) That it started out fresh and has become progressively saltier,
b) That it started out very salty and has become progressively fresher,
c) that salinity has varied widely and irregularly both above and below its present value,
d) that salinity has remained virtually steady throughout much of geologic time.

One method of attack is to examine the geo-chemical balance sheet — to test the assumption that throughout all time the quantity of material weathered and eroded from crystalline and older sedimentary rocks as they were exposed, plus new or juvenile matter from volcanic gases, hot springs, etc., about equals the quantity of material in sediments deposited on continental platforms and on the deep-sea floor, plus matter stored up in sea-water and atmosphere.

Mr. Rubey found remarkably good agreement where the commoner rock-forming elements such as silicon, aluminum, iron, calcium and a half-dozen other things are concerned. But for another group

WILLIAM W. RUBEY

which he calls the "distillable spirits" of the earth's solid matter — water, carbon dioxide, chlorine and nitrogen — there is no such agreement.

"All the constituents of this latter group" he said, "are much too abundant in the present atmosphere and hydrosphere and in ancient sediments to be accounted for as simply the products of rock weathering — the explanation that fits well enough for the other elements. Compared with the common rock-forming oxides, the members of this other group are all relatively volatile."

In other words, a tabulation of how these "volatiles" are now distributed on and near the surface of the earth — in the atmosphere, ocean, fresh water and organic matter, or buried in sedimentary rocks — leaves a considerable excess of volatiles that cannot be accounted for as simply the products of crystalline rock weathering.

"Only two possible sources of these 'excess' volatiles occur to me," he told fellow geologists: "either they are largely or entirely residual from a primitive atmosphere and ocean; or they have

largely or entirely risen to the surface from the earth's interior during the course of geologic time."

Examining one argument that postulates the earth was probably once molten throughout with all or a large part of the water, carbon dioxide, etc., volatilized in a primitive atmosphere (that condensed after cooling to establish a primitive ocean beneath the gaseous envelope), Mr. Rubey said that upon close examination, "this conclusion is not altogether convincing.

"To begin with, it is by no means certain that the earth was originally molten. It has been pointed out frequently that the simple fact of much water and very little neon on the earth today means that water was bound in solid compounds and therefore relatively cold when the earth's materials accumulated.

"This leaves us with two alternatives; either the earth remained solid from the beginning, except for local melting; or it was first cold, then heated by some process until molten throughout, and finally it solidified again. Whichever one of these two theories may ultimately prevail, the evidence appears distinctly unfavorable to the concept of an atmosphere that ever contained very much of the earth's total volatiles.

"Instead, this evidence seems to call for some mechanism by which the volatiles were largely retained within the interior of the earth, to the extent of about one or two tenths of a percent of the solid matter. This appears entirely possible whether or not the earth was ever molten."

"Is there some reasonable mechanism by which these gases from the interior could be the source of the 'excess' volatiles," he asked, suggesting that "in the cooling and gradual crystallization of complex silicate melts, certain minerals crystallize out first and thus enrich the remaining melt in other constituents, among them water, carbon dioxide, and other volatiles. As crystallization proceeds the concentration of these remaining volatiles rises and therefore also their vapor pressures.

"When these vapor pressures become greater than the weight of overlying rocks," he observed, "escape to the surface may be violent, as in volcanic eruptions; or where the cooling melt lies at greater depths, the volatiles may escape more gradually along fractures in the overlying rocks.

"How adequate is such a mechanism to explain the quantity of volatiles that have risen to the earth's surface? It appears probable that the total quantity of extrusive rocks that has risen to the earth's surface in all of geologic time, although very large, is still insufficient to furnish more than about one or two percent of the water of the ocean, even if we assume a rather high water content in the lavas. Intrusive rocks, however, are a more likely source. Goranson's experimental work has shown that a melt of granitic composition can dissolve as much as 9 percent of water at 900° C and at a pressure equivalent to a depth of 15 kilometers. Nonetheless the water in natural magma is a subject about which petrologists dispute. Gilluly has estimated that the water content of many magmas has commonly been between 4 and 8 percent.

"Let us take the lower of his two estimates. Then, as igneous rocks now contain an average of about 1 percent water, this would mean that magmas have commonly given off about 3 percent by weight of water during cooling. On these assumptions, the crystalliza-

	X 10^{20} grams					
	H_2O	Total C as CO_2	Cl	N	S	F, Br, B, H, A, etc.
In present Atmosphere, Hydrosphere and Biosphere	14,600	1.4	275	39	13	6.5
Buried in Ancient Sedimentary Rocks	2,100	920	30	5.0	15	15
TOTAL	16,700	921	305	44	28	21.5
Supplied by Weathering of Crystalline Rocks	100	11	5	0.6	6	3.5
"Excess" Volatiles unaccounted for by Rock Weathering	16,600	910	300	43	22	18

Estimated quantities of volatile materials now concentrated on and near the earth's surface, compared with quantities of these materials that have been supplied by the weathering of rocks. The "excess" volatiles unaccounted for by rock weathering have probably escaped gradually to the earth's surface from cooling magmas, thus permitting a relatively constant composition of sea water and atmosphere through much of the geologic past.

tion of a shell of igneous rock 25 miles thick would account for the entire volume of water in the ocean. In a similar calculation, it has been estimated that the ocean could have been derived from the escape of 5.8 percent of water from the sialic rocks of the earth's crust.

"Hot springs are much less spectacular than volcanoes but they are more numerous and widely distributed, and they may be the principal channels by which volatiles escaping from crystallizing magma have reached the surface. For example, Allen and Day have estimated, from the temperature of escaping steam in Yellowstone Park, that the hot springs of that area are discharging ground water that has been heated by mixing with about 10 or 15 percent of magmatic steam."

The speaker offered a crude estimate of the total quantity of water being discharged from the present hot springs of the earth based on the assumption that the 1059 known thermal springs or groups of springs in the United States are a typical cross section of conditions found elsewhere on the globe.

If the distribution of hot springs in the United States is a fair sample, he says, then "the annual discharge of all hot springs, multiplied by two billion years (the probable age of the earth), gives a total volume of water which is slightly more than 100 times that of the present ocean. That is to say, if hot springs are delivering to the surface an average of only nine-tenths of one percent of juvenile water, they could in the course of geologic time, account for the entire volume of the ocean."

Mr. Rubey suggested too, a possible mechanism whereby local masses of water-bearing, molten rock might be generated more or less continuously throughout geologic time. Observing that the rise in temperature with depth varies in temperature from place to place,

but that below a depth of 30 to 60 miles, rocks are probably heated to to temperatures at which they would melt (if the confining pressures were not so great), he finds "several processes may operate to cause local melting.

"As sediments accumulate in a region, their low thermal conductivity makes them act as a blanket to impede the upward flow of heat. In geosynclinal troughs, where sediments accumulate to great thicknesses the entire column of underlying rocks is depressed into zones where the temperature is significantly higher. Temperatures may thus be reached at which some of the minerals in the deeper rocks are melted.

"Moreover, as strains accumulate in the earth's crust and the rocks eventually fail by fracture, sudden localized relief of pressure and shearing stresses may, without increasing the temperature, bring some of the minerals above their melting points. As has been shown, such selective fusion of the lower-melting minerals would form magmas more granitic and richer in volatiles than the original rock.

"Fusion would cause increase of volume and the resulting magmas would tend to rise, partially recrystallizing as they moved into higher, cooler zones. By this mechanism, the volume of granitic rocks would increase near areas where the crust is unstable; and as these unstable areas migrated with the continental margins and the sites of mountain-making, the granitic rocks would increase progressively in area and in thickness."

This leads to an important corollary of the suggested mechanism. If granitic rocks have grown progressively in area and thickness through geologic time, establishing a balance between rock masses of varying weight and density would require more or less continuous readjustments, by which the thickening blocks of these granitic or continental types of rocks would rise higher and higher above adjacent blocks of heavier material.

In another terminology, "this would mean" he said, "that the ocean basins have sunk at approximately the same rate as the volumes of granitic rocks and sea water have grown, then it is no coincidence, but the effects of one single process, that the surface of the sea has oscillated back and forth near the same level on the continental shelves throughout the geologic past."

Examining another line of evidence that affords considerable information about the probable composition of sea water and atmosphere in the past, Mr. Rubey commented on the dependence of all living things upon fairly stable chemical and physical conditions. This would include an adequate supply of oxygen and the presence of just the right amount of ozone in the upper atmosphere to absorb most of the deadly ultraviolet radiations yet allow enough to pass to form the essential anti-rachitic or "sunshine" vitamin.

Likewise, many species of modern invertebrates can tolerate only narrow ranges in the salinity of their environment because of the osmotic pressures involved. A more saline environment would have the same effect as putting salt on a garden slug. "Many organisms have very specific requirements, on the one hand, and tolerances on the other, for the amounts of dissolved sodium, calcium, potassium, and other elements in the waters in which they live" Mr. Rubey pointed out. "It seems not unlikely that the ancestors of some of these modern forms were

subject to similarly rigid requirements . . . Paleontologists have given relatively little attention to chemical factors in the environment of ancient organisms . . . The most definite information about the paleochemistry of sea water and atmosphere may come eventually from the biologists, though the best evidence now available seems to lie in a comparison of the composition of rocks that have been weathered and of sediments that have been deposited during the geologic past."

Mr. Rubey pointed out that the balance between the carbon dioxide in the atmosphere and what is in the surface waters of the earth is delicate. While sea-water may vary widely in its total salinity, it varies scarcely at all in the proportions of its different dissolved constituents. The most significant exceptions to this statement are quantities of bicarbonate and carbonate ions, which depend only in part upon salinity but are affected much more by the hydrogen-ion concentration and by the amount of carbon dioxide in the atmosphere with which the water is in contact.

The conclusion seems unavoidable, he said, that for a larger part of geologic time carbon dioxide has been supplied to the atmosphere at about the same rate it has been subtracted by sedimentation.

In order to evaluate the geological significance of a relatively constant amount of carbon dioxide in the atmosphere-ocean system through much of the past, he prepared a table attempting to bring together an inventory of separate estimates to arrive at a figure for the total carbon dioxide and carbon on and near the surface of the earth today.

But where did it all come from?

We can dismiss at once the possibility that all of it has been supplied from a primeval atmosphere which the earth might have inherited when the planets were torn from the sun, he asserts.

If this carbon had merely been subtracted from such an original atmosphere, which the earth might have inherited when the planets were torn from the sun or simply born from chaos, the early seas would have been strongly acid, calcium carbonate could not have been deposited from them, and life as we know it today would probably never have had a beginning.

His conclusion is that the amount of carbon dioxide in the atmosphere-ocean system has remained relatively constant, and that it has been supplied to the atmosphere more or less continuously through the same hot springs that supply new water.

Two Strong Earthquakes On Pacific Ocean Floor

WASHINGTON, Dec. 15 (Science Service) — Two very strong quakes rocked the floor of the Pacific Ocean within 12 hours of each other. Both were of magnitude 7.7, within one of the highest rating possible.

One quake occurred near the coast of southern Mexico at 9:00 a.m. EST, Thursday, Dec. 14. Approximate epicenter, located by the U. S. Coast and Geodetic Survey with the cooperation of Science Service, was 16 degrees north and 98 degrees west.

The other quake hit the Tonga Island region of the Pacific at 10:00 p.m. on Wednesday, Dec. 13. Its epicenter was approximately 22 degrees south and 98 degrees west.

LETTERS TO THE EDITOR

Ann Arbor, Michigan
December 30, 1950

Dear Mr. Eisenberg:

Mr. Zatterstrom, in his communication of October 24,* questions the use of the designation "Wingate ss. (Entrada of the U.S.G.S.)" in the Jurassic of the generalized section of northwestern New Mexico which appeared with an article by the writer in the September issue.

This extended reply, we trust, will shed some light on the reasons for the apparent contradiction in terms. The "parallel" case of confusing two dissimilar dinosaurs, cited in good humor by Mr. Zatterstrom (with a glance toward the vertebrate paleontologists) does not hold. We were dealing very evidently with one sandstone unit, not two, and the problem was what name to give to it. The pros and con are cited here as succinctly as possible and the reader may make his choice.

The formations with which we are concerned have been given by Reeside, Gilluly and Moore (for southeastern Utah, in ascending order) as the Wingate, Kayenta and Navajo, all of the Glen Canyon group; the Carmel, Entrada, Curtis and Summerville of the San Rafael group; and the Morrison.

However, the Kayenta, Navajo, Carmel and Entrada wedge out to the southeast and, following Baker, Dane and Reeside (U.S.G.S. Prof. Paper 183, 1936), "the Wingate is all that is left of both the Glen Canyon and San Rafael groups" from Todilto Park, in northwestern New Mexico southeastward . . . "The Entrada thins out upon the Wingate," (near the Arizona-New Mexico border) . . . the Wingate continuing into New Mexico.

In 1947, the same authors published a "Revised Correlation of Jurassic Formations of Parts of Utah, Arizona, New Mexico and Colorado" (A.A.P.G. Bull., vol. 31) in which they assert:

". . . The Entrada sandstone of western Colorado has been recognized to extend into the area east of the Front Range and a considerable volume of evidence has been adduced that indicates that the Entrada extends into northeastern New Mexico, where it is the Jurassic sandstone that was designated by the writers as the Wingate sandstone.

". . . The writers are in agreement with C. B. Read and his associates that the Jurassic sandstones at the type locality of the Wingate, at several localities in the Chama Basin and farther eastward in New Mexico are the same and are equivalent to the Entrada sandstone.

"Obviously these new conclusions as to correlation pose a problem in stratigraphic nomenclature. A strict application of the principles of priority would require that the name Wingate sandstone be now applied to the stratigraphic unit heretofore called Entrada, and would also require that a new name be applied to the Wingate sandstone of Utah and adjacent regions . . . but in the opinion of the writers the abandonment of this nomenclature through the applications of the principles of priority would be unfortunate and confusing.

"Accordingly, the name Entrada sandstone is extended to include the sandstone of the type locality of the Wingate sandstone and the name Wingate is retained for the sandstone forming the lower part of the Glen Canyon group, with the understanding that the original type locality of the Wingate has been abandoned.

"For the present, the name Glen Canyon group is extended to include the undivided equivalents of the Navajo, Kayenta and Wingate that crop out below the Entrada sandstone and above the Chinle formation in parts of New Mexico and Arizona."

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*(Ed.: see "Letters to the Editor", **Earth Science Digest**, Nov. 1950, p. 2.)

In compiling the generalized section of northwestern New Mexico for the fourth field conference of the Society of Vertebrate Paleontology, Stuart A. Northrop of the University of New Mexico retained the name Wingate, however, and gave the following reason:

"Baker, Dane and Reeside (1947) stated that the Wingate of New Mexico is the Entrada of Utah and Colorado and that what has long been called the Wingate of Utah is an entirely different unit. Dutton's term Wingate, from the Fort Wingate area, near Gallup, N. M., was proposed in 1885 and clearly has priority over the name Entrada, proposed in 1926 from the San Rafael Swell, Utah. However, Baker, Dane and Reeside . . . abandoned the Fort Wingate type locality of the Wingate, called the "Wingate" of Utah the Wingate, and substituted Entrada for the Wingate of New Mexico.

"The editors of this guidebook** prefer to retain the name Wingate in its original type designation for the sandstone Dutton recognized as 'the most conspicuous stratigraphic member of the whole region', out of which 'have been carved the most striking and typical features of those marvelous plateau landscapes which will be subjects of wonder and delight to all coming generations of men'."

The guidebook editors also retained formational status for the Todilto (regarded by the U.S.GS. [1947] as a member of the Wanakah formation), formerly a member itself of the Morrison, holding that "the Todilto of northern New Mexico . . . is definitely a readily mappable unit."

Very sincerely,
HENRY P. ZUIDEMA

**(Stuart A. Northrop and Edwin H. Colbert.)

Washington, D. C.
November 27, 1950

Dear Mr. Eisenberg:

On Sept. 30, 1950 representatives of the Gem Cutters Guild of Maryland, the Lapidary Club of Washington, D. C., and the Mineralogical Society of the District of Columbia met in Washington, D. C., and laid the foundation for the organization of the Eastern Federation of Mineralogical and Lapidary Societies. Mr. H. L. Woodruff of Washington, D. C. was elected President, Mr. David E. Wallis of Baltimore, Vice President, Mr. B. J. Chromy of Washington, Secretary and Mr. James H. Benn of Washington, Treas. The basic provisions of the Constitution and By Laws were discussed and voted on and a tentative Constitution and By Laws was adopted, however, with the provision that the final adoption thereof would be left open until Feb. 1, 1951. It was decided that all societies that join the Eastern Federation on or before February 1, 1951 shall constitute charter members. It is the sincere desire of the organizers that the Eastern Federation shall be truly representative of all of the societies east of the Mississippi and Ohio Rivers. All societies in this territory desiring to affiliate themselves with the Eastern Federation are invited to apply for membership in time so that they may obtain charter membership. This information is being passed on to you for use in your publication if it is possible for you to do so since it is felt that other Federations, the members of which subscribe to your magazine, might be interested in knowing of the formation of the Eastern Federation.

Very truly yours,
B. J. CHROMY, Secretary
Eastern Federation of Mineralogical and Lapidary Societies

Cover Photo

Pyrite (FeS_2), magnified 2.2 million diameters, provides an interesting subject for this month's cover photo. This picture was taken by Dr. Martin J. Buerger with his new two-wavelength microscope. The mineral is seen looking along a crystallographic **a** axis. See "Individual Atoms in Minerals Photographed", by Herbert B. Nichols, p. 16-18.

INDIVIDUAL ATOMS IN MINERALS PHOTOGRAPHED

HERBERT B. NICHOLS
U. S. Geological Survey

A novel rearrangement of microscope lenses and very carefully prepared fragments of mica has enabled a mineralogist at the Massachusetts Institute of Technology to reach phenomenal magnifications permitting one to actually see atoms for the first time.

In a paper before the Geological Society of America, holding its annual meeting in Washington, Dr. Martin J. Buerger of the MIT Geology Department described apparatus that he called a "general microscope." It first uses light from the x-ray portion of the spectrum to produce a diffraction image of a crystal under inspection, then substitutes light of a second wavelength to continue on through the rest of the optical system. As described it sounded very much like a relay in which two different runners (kinds of light) carry the baton (atomic picture).

He showed that for such a microscope, a single model of which he perfected in February of this year, magnification depends not only on the ordinary image-to-object distance ratio, but also on the ratio of wavelength used.

This means that in order to see or photograph the individual atoms in a crystal — achieving magnifications approaching a million diameters (8×10^6) it is necessary (1) to cause x-rays to be diffracted by the crystal, (2) arrange the diffraction pattern as though it has been caused by ordinary light and focused with a lens, then (3) substitute visible light in the path that the x-rays would have taken if they could have been focused.

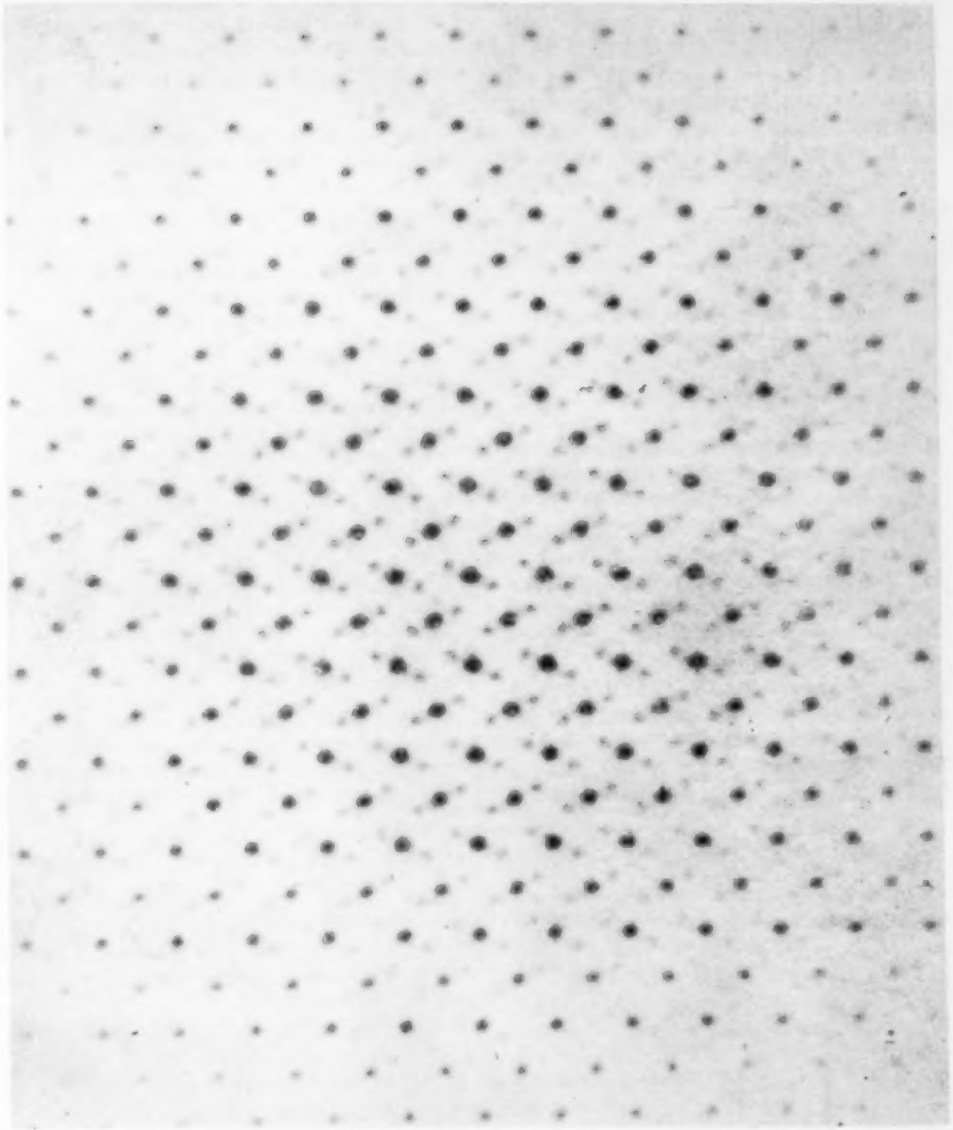
Due to the loss of phase which occurs when visible light is substituted for x-rays during the second stage, it is necessary to use "phase shifters" composed of mica of uniform thickness.

The source of light is a water-cooled mercury arc, specifically the General Electric A - H6. The mercury green line is isolated from the arc spectrum. Shorter wavelengths are eliminated by a Wratten filter #12, placed permanently behind the lens of the microscope objective. In photography, the longer wavelengths, particularly orange, are eliminated by using orthochromatic film.

The mercury arc illuminates a very small pinhole, which must not be larger than 0.0001 inches in diameter and is preferably considerably less, in order to resolve details in the individual atoms of the image.

Any phase shift whatever can be imposed on the rays scattered by a point of the reciprocal grating, by interposing in the path of the rays going through the point a tilted flake of mica which has been ascertained to have a truly uniform thickness. This was demonstrated by Prof. Buerger as early as 1941.

For this purpose a thin cleavage flake having as large an area as possible is separated from an ex-



Marcasite (FeS_2), magnified 2,2 million diameters, seen looking along the crystallographic C axis. Photo by Martin J. Buerger.

cellent crystal of mica. The thickness uniformity is easily judged by a very simple interferometer method: The flake is merely held close to a broad, strong source of monochromatic light. Where the flake has a uniform thickness the interference fringes will be without discontinuities and a large area is selected for the purpose of cutting out the phase shifter units previously described.

Professor Buerger cautioned that the development described does not mean that now any crystal structure whatever can be

photographed. "It does mean," he said, "this can be done provided that the phases which must be set with the mica phase shifters are known."

To know the phases requires, in effect, that the locations of the atoms are known. But when the phases are not known, which is the state of affairs as a new crystal structure is first examined, the apparatus automatically gives the physicist certain clues by which this can be determined through calculation.

This general procedure was first attempted by the British physicist, Sir Lawrence Bragg, but his experimental devices could only be applied to imaging a vanishingly small class of crystals. The key to the whole general system as developed by Professor Buerger is the device by which the phases of the diffraction spectra are changed — the mica shifters. It should be especially understood that the only way that has been found to imitate the X-ray phase in the final step is by interposing the small, tilted, mica windows in each of the diffraction spectra after the substitution of visible light.

In theory the light that comes from a diffraction pattern is brought to a focus by a lens, whereupon the narrow beams of light must superpose in such a way as to produce an image of the atomic pattern of the crystal, exactly as they do in an ordinary light microscope. When this is magnified about a million times as described, it is still a bit small and must be magnified still further by an auxiliary microscope that produces a final image viewed either directly or indirectly through photography.

Professor Buerger exhibited photographs to the assembled geologists showing the patterns of atoms in crystals of pyrite, marcasite, and KH_2PO_4.

The technical report on the new two-wavelength microscope appears in the September issue of the **Journal of Applied Physics.**

CHICAGO MUSEUM ACQUIRES INDIANA FOSSIL COLLECTION

The Chicago Natural History Museum recently acquired the major part of the fossil collections of the Hovey Museum of Wabash College, Crawfordsville, Indiana. The specimens are now being unpacked, accessioned, and added to the study collection of the department of geology. Among a small number of vertebrate fossils is the type specimen of a primitive American camel, **Procamelus hesternus** (Leidy). Invertebrate fossils constitute most of the collection, including many fine specimens of Mississippian crinoids from Crawfordsville, a classic locality from which complete specimens were taken in great abundance two generations ago. There are few places where one may collect complete fossil crinoids, as these animals almost invariably disintegrate into millions of tiny pieces of crystalline calcite upon death unless buried rapidly in perfectly still water. The classic localities such as Crawfordsville are now almost entirely "worked out."

The Hovey Museum was named for Edmund Otis Hovey, one of the founders of Wabash College, who taught the courses in natural science. It was he who discovered the famous crinoid beds of Crawfordsville and presumably collected most of the fine crinoid specimens included in the collection.

In the study collection at the Chicago Natural History Museum these fossils will henceforth be available for any scholar to examine and will facilitate the work of the department of geology in making determinations of fossils submitted for identification.

Alaskans, 12,000 Years Old, Called Earliest Americans

MARJORIE VAN DE WATER [Science Service]

WASHINGTON, Dec. 19 — Digging deep in the icy soil of northern Alaska, Robert J. Hackman, a U. S. Geological Survey worker, found remains of a camp site where prehistoric Americans bivouacked some 12,000 year ago.

This discovery was announced here by the Smithsonian Institution, which has received from Mr. Hackman a considerable collection of stone points, work of the ancient people.

The collection includes lamellar flakes and burins similar to those found by Dr. J. L. Giddings, of the University of Pennsylvania, under seven feet of soil on Cape Denbigh. The Giddings finds are considered the oldest work of man in the New World and resemble the work of Stone Age man in the Old World. The new collection was found buried about ten inches deep in Anaktuvuk Pass through the Brooks Range in northern Alaska.

A similar find was made independently at about the same time by William Irving, a student at the University of Alaska. Mr. Irving's discovery was made not far from Mr. Hackman's, and it was also probably remains of a bivouac on the trail taken by the first Americans from the Alaskan coast to the interior of the North American continent.

In addition to the flakes like the Cape Denbigh culture, the Hackman collection includes some Folsom-like points which link this ancient people to ancient man in the United States Southwest. There were also points of unique design.

Unfortunately, no organic matter was found with the stone points that could serve to date them by the radioactive carbon calendar method. Antiquity of the specimens was calculated from study of the geology of the site and the style of workmanship of the points.

Another Geological Survey worker, Milton C. Lachenbruch, found two Folsom points near the headwaters of the Noatak River, just beyond the Brooks Range. This site was probably a third bivouac in the great migration.

Pacific Northwest Minerals Described

Identifications and detailed descriptions of eleven uncommon minerals found recently in the Pacific Northwest are contained in a Bureau of Mines report just released. Six specimens of these uncommon minerals — allanite, native antimony, boulangerite, glaucodot, manganophyllite, and plumbojarosite — were found in Idaho; chromium mica and geocronite were picked up in Washington; specimens of pseudomalachite and pyromorphite came from Montana; and a sample of kotschubeite came from the Canyon City area of Oregon.

The single previous occurrence of glaucodot in this country had been reported in Grand County, Ore. Although kotschubeite had previously been reported occurring only in the southern Ural Mountains in Russia, a sample found in Del Morte County, Calif., has been in the Bureau's collection some time, the report states. Allanite, a comparatively rare variable silicate of aluminum, iron, the cerium metals and yttrium occurring generally in microscopic quantities, has been found in localities in several states — New York, New Jersey, Pennsylvania, Virginia and Texas. The publication includes optical, x-ray and spectrographic data and numerous references to previously published information on these minerals.

A free copy of Report of Investigations 4721, "A Study of Certain Uncommon Minerals Found in the Pacific Northwest," by A. J. Kauffman, Jr., D. M. Mortimore, and H. D. Hess, of the Bureau's Northwest Electrodevelopment Laboratory, may be obtained by writing to the Bureau of Mines, 4800 Forbes Street, Pittsburgh 13, Pa.

Lemur-Like Mammals Found in New Mexico

WASHINGTON, Nov. 18 — Dr. Robert W. Wilson of the Museum of Natural History, University of Kansas told the Society of Vertebrate Paleontology today of two new lemur-like mammals probably belonging to the primates, the highest order (which includes man). These were found in middle Paleocene rocks of the San Juan Basin, New Mexico.*

Although primates have been long known from rocks of middle Paleocene age, a time more than 57 million years ago when higher mammalian forms were just beginning to rise, these particular mammals have remained unrecorded. They are of special interest to paleontologists because they and suposed related kinds from other localities show greater differentiation and specialization even at this early date in an order of mammals which was later to include mankind — **Homo sapiens.**

The most primitive primates are called lemurs, and these are now rare and confined to the tropical rain forests of Africa, Madagascar and southern Asia. Two interesting relic animals of this group are the so-called aye aye, native to Madagascar, and the tarsier, now confined to Borneo, Celebes, Java, Sumatra and the Philippines. Ancestors of these and other lemurs are found in Paleocene and Eocene rocks of North America and Europe, but they became extinct there. In fact, all primates are unknown in North America from shortly after the close of the Eocene until the comparatively recent appearance of man.

Dr. Wilson emphasizes that his specimens are probably, but not certainly primates; that they are no older than others that have been known by printed record since 1923; and that they are not involved in the direct ancestry of man.

"They will probably do little more than complicate in a minor way the already complex problem of early primate history," he adds. "Two genera, one or both new, are represented by upper jaws. Lower jaws were also recovered, but these are less well preserved, less definitely primate.

"The fossil record of the primates," he continued, "is known as far back as the middle Paleocene (Torrejonian) where it is represented by a number of different kinds of mammals which can be assigned to the order with varying degrees of probability. These animals are currently assigned to four different families and seven different genera. At present, published records of primates for this age are limited to the Crazy Mountain area of Montana and the Big Horn Basin of Wyoming.

"But the classical continental fauna of the middle Paleocene is that from the Nacimiento formation of the San Juan Basin in New Mexico. Although fossil mammals have been collected from the Nacimiento from 1881 to the present day, it was not until 1948 that anything of primatelike aspect was obtained."

It was during the summer of 1948 that a University of Kansas party working in Kutz Canyon found an upper jaw and two very doubtful lower jaw fragments. This

*(Ed.: See "Fossil Localities of Northwestern New Mexico," by Henry P. Zuidema, **Earth Science Digest**, Sept. 1950, p. 3-9.)

past summer, more and better material was obtained which has not completely prepared as yet.

Dr. Wilson says that this second collection consisted of a poorly preserved skull, another upper jaw, another lower jaw fragment and a fairly complete mandible. "It seems that the New Mexican material represents only one of the four families known from the middle Paleocene," he says, "the Anaptomorphidae — which is not in itself very revealing for that family is currently something of a wastebasket for various small primates of the Paleocene and Eocene. Some of the anaptomorphids, however, do show pronounced resemblance to the living tarsier of the Philippines."

Two of the specimens have the upper dentition better preserved than in any of the described anaptomorphids from Montana, but special interest centers around the skull. Though poorly preserved and not yet prepared this specimen is nevertheless the most complete skull of a primate known from rocks as old as the middle Paleocene.

GEOLOGICAL SURVEY PROJECT IN BRAZIL NOW UNDER POINT FOUR

WASHINGTON, Dec. 12 — A 10-year mineral investigation program in Brazil now under way — the first step toward establishing a large-scale export of vitally-needed iron ore — has just been approved for continuance as a Point Four project.

The U. S. Geological Survey is cooperating in this program at the request of the Brazilian Government to determine the quantity and grade of iron ore and of manganese deposits in the State of Minas Gerais. The cooperative program was started in 1940, and later a 1948 Brazilian-United States agreement provided for its continuance until 1958. It will now be carried on by authority of the International Development Act (Public Law 535) which provides for United States technical cooperation with other countries.

Under the Point Four program six geologists of the Geological Survey will conduct investigations of the high grade iron ore and manganese deposits in Minas Gerais, and will do topographic mapping. The approved Point Four project also calls for compilation by United States geologists of an overall base map of the Brazilian iron country in cooperation with the Southern Cross Company (Cruzerio da Sul) of Brazil.

While Brazil iron resources have long been known to be among the largest in the world, precise data about distribution and grade have been lacking. Results of the current project will provide vitally-needed minerals for defense and other purposes. Certain phases of the work have been completed under the former agreement, including a number of geological compilations and topographic ground control work within the iron country, as well as a review of Minas Gerais manganese deposits. Also the Brazilian Government has secured air photo coverage of the iron country for preparation of topographic base maps.

Two of the six Department of the Interior geologists who will work on the project under the Point Four program have already received assignments for Brazil. Joel B. Pomerene, former assistant geologist with the Inland Steel Co. of Ishpeming, Mich., left for Belo Horizonte, Minas Gerais, in November. Garn A. Rynearson, who has recently been specializing in chromite deposit studies in California for the Geological Survey, will depart for So. America in January.

IRON DEPOSITS OF NORTHERN NEW JERSEY STUDIED

WASHINGTON, Dec. 12 — Studies of the commercially valuable iron deposits of northern New Jersey, some within 35 miles of New York City, have been completed by the Geological Survey. The three largest producing iron mines in New Jersey together with many abandoned mines that formerly yielded a substantial part of the State's production are within the Dover magnetite district in the northern part of the State. Production from the active mines — Mt. Hope, Scrub Oaks and Richard — is now about 500,000 long tons a year.

The Mt. Hope mine has been active since 1710, and is reputedly the oldest operating iron mine in the United States. During the Revolutionary War the mines from this district supplied local forges with ore to provide iron for the Continental Army's shot and cannon.

Scientific studies of the region were begun by geologists of the Geological Survey in 1947, as a part of a cooperative investigation by the Geological Survey and the Bureau of Mineral Research Rutgers University, and a preliminary report has been written for immediate public use, by Paul K. Sims. The report was prepared with two purposes in mind: to provide precise knowledge of the local magnetite deposit, and to present detailed scientific data that will aid in interpreting the geology of the crystalline rocks of the New Jersey Highlands.

An immediate outcome of the work has been to provide operators of local mines with a better understanding of the geologic problems related to mining. The deposits are tabular or lath-shaped bodies that are composed of massive or disseminated ore. These bodies range in thickness from less than 1 foot to about 60 feet, and average between 10 and 20 feet.

The rocks of the region have been complexly deformed and broken by earth movements, and it is of primary importance for mine operators to be able to locate displaced ore bodies without indiscriminate and costly blasting operations. Definite fracture patterns were determined which will aid the miner in locating such displaced deposits.

The preliminary report includes not only detailed descriptions of the mine areas, but also describes the regional setting of the mineral deposits. The ancient crystalline pre-Cambrian rocks in the Raritan and Passaic quadrangles were subdivided into units that are sufficiently distinct and continuous to serve as mappable formations. Similar subdivisions can be made in other regions throughout the New Jersey Highlands, and in adjacent states, according to the author.

The relationship between the magnetite deposits and the enclosing pre-Cambrian rocks, the persistence and structure of the magnetite deposits, and the areas favorable for exploratory work are discussed in the body of the report. These geologic studies suggest that the total extent of each of the deposits is greater that has hitherto been known.

The ore bodies occur in three principal types of hot rocks — granite, gneiss, and skarn* — and a substantial production has come from each type. In most deposits the ore is composed almost entirely of magnetite, although hematite is present in some ore bodies. Sulfides are generally absent except in the Green Pond ore zone.

The ore bodies were formed by replacements of the host rock. The deposits in gneiss and granite were localized within granulated and crushed zones where the ore-forming solutions could move

*(Ed.: the silicate minerals or gangue associated with the iron ore.)

more freely. The solutions are believed to have been derived from the consolidation of bodies of granite from molten rock at levels deeper than are now exposed.

The report entitled "Geology of the Dover magnetite district, New Jersey," is accompanied by a geologic map of the district, a structure map, a block diagram of the Mt. Hope mine, and other illustrations. Copies of the report and illustrations are not available for distribution but may be examined at the Geological Survey, Room 1033 (Library), General Services Building, Washington, D. C.; Bureau of Mineral Research, Rutgers University, New Brunswick, N. J.; at the Library, Princeton University, Princeton, N. J.; and at the office of the State Geologist, State Department of Conservation and Development, Trenton, N. J.

Floods Highlight Water Resources for November

WASHINGTON, Dec. 11 — Floods from heavy rains on both sides of the continent highlight the Nation's water picture for November as it was reported by Geological Survey hydrologists in the latest **Water Resources Review.**

High water was reported generally throughout New England and Canada's Maritime Provinces, with record-breaking floods in Pennsylvania and New York. On the west coast runoff was excessive throughout most of the Columbia River Basin and outstanding floods were recorded for California and Nevada.

Nevertheless, the runoff pattern in the West as a whole continues much the same as has existed for many months despite the record-breaking flood flows in most of the main streams draining the Sierra Nevada from Yuba River south to Kern River. There the floods were the result not only of a series of rain storms but were swelled by an almost complete melting of the snow cover in northern California during the period of November 15-22. Flood conditions still persist in Nevada as a result of heavy rains December 2-3.

Runoff in the Colorado River Basin continues generally deficient and at Grand Canyon was recorded at only 83 percent of normal. Despite flood conditions in northern California the drought in the southern part of the State continued with little change during November. Ground-water levels continued to decline in Cuyama Valley with the level in one well the lowest since the record began in 1941

Elsewhere in the Nation the picture was spotty. Drought conditions prevailed throughout Texas; the water levels in many wells in Kansas that reached their highest recorded stages during October are 2 feet higher than their average level for November; Indiana recorded runoff at key gaging stations as "excessive", averaging 700 percent of normal. Indiana lakes were generally slightly higher than normal.

Flint Pieces Believed Wealth of Prehistoric Indian

URBANA ,Ill., Dec. 13 (Science Service) — Flint pieces that may have been part of the wealth of a prehistoric Indian are now at the University of Illinois. The pieces range from raw blocks to expertly fashioned big spear points. Prof. John C. McGregor, University of Illinois archaeologist, believes the spearheads are much too finely-made to have been used for hunting or war. Most likely they were a medium of exchange, he has concluded.

The cache was uncovered in Calhoun county between the Mississippi and Illinois Rivers, northwest of St. Louis. In this area are many remains of the prehistoric Hopewell or mound-builder Indians. Radiocarbon dating set the time of their culture at 200 to 600 B. C.

Earth Science Abstracts

[Selected articles on the earth sciences, appearing in current scientific publications, are abstracted here for the convenience of our readers.]

PHYSICAL GEOLOGY

CENOZOIC MARINE CLIMATES OF THE PACIFIC COAST. J. Wyatt Durham. **Geol. Soc. Am. Bull.,** v. 61, n. 11, p. 1243-1264, Nov. 1950. "The data available from the regions surrounding the Pacific Ocean during the early Tertiary indicate that the poles and continents could not have been in the positions postulated by Wegener, Du-Toit, or Grabau, but were in approximately the same positions as at present. During the Paleocene, the 20°C. marine isotherm was north of 49° N. latitude, by middle Oligocene time it had started to shift south of that position, by middle Pliocene it had approached its present position. During the Pleistocene it oscillated both northwards and southwards."

LOESS FORMATIONS OF THE MISSISSIPPI VALLEY. Morris M. Leighton and H. B. Willman. **Jour. Geology,** v. 58, no. 6, p. 599-623, Nov. 1950. "The loess deposits of the Mississippi Valley area are widespread and have been extensively studied. In the upper valley they have definite stratigraphic relationships to the drift sheets. From these relationships they are known to have a definite stratigraphic sequence, and their ages have been, in the main, closely determined. They show an eolian genetic relationship to source areas by their thickness, texture, structure, topographic position, and percentage composition of carbonates. Their eolian origin is also indicated by their faunal and, in places, floral assemblages. Some of the loess deposits also reflect the climatic conditions under which they accumulated and the rate of deposition with respect to rate of solution of carbonates. Where they carry plant fossils, the nature of the vegetation which was growing on the surface at the time of deposition is recorded . . ."

PEDIMENTS AND PEDIMENT-FORMING PROCESSES NEAR HOUSE ROCK, ARIZONA. Victor C. Miller. **Jour. Geology,** v. 58, no. 6, p. 634-645, Nov. 1950. "At the base of the East Kaibab monocline, 6 miles south of House Rock, Arizona, stand two levels of pediment remnants, cut largely in Moenkopi red shales and capped by boulders and gravels of Kaibab limestone. The pediments are produced primarily by lateral corrasion by master-streams, aided by rill-wash and gully erosion. Pediment-cutting has been interrupted by periods of aggradation in which protective gravels were spread upon the pediments."

SEA BOTTOM OFF THE COAST OF CALIFORNIA. Andrew C. Lawson. **Geol. Soc. Am. Bull.,** v. 61, n. 11, p. 1225-1242, Nov. 1950. This paper is a review of "Submarine Topography off the California Coast: Canyons and Tectonic Interpretations," Geol. Soc. Am., Spec. Paper 31, by Francis Shepard and K. O. Emery, 1941. The salient features of the sea bottom off the coast of California are sketched and classified, and some questions as to their genesis are discussed.

STRUCTURAL GEOLOGY

DIABASE OF THE GEORGIA PIEDMONT. J. G. Lester and A. T. Allen. **Geol. Soc. Am. Bull.,** v. 61, no. 11, p. 1217-1224, Nov. 1950. "The crystalline area of Georgia, comprising more than 17,000 square miles, was studied for the occurrence of diabase. Fifty-seven new dikes were mapped and specimens

from them examined under the microscope. No sill-like bodies were encountered and no flows or remnants of flows exist in the area. No definite age can be given to the diabase in Georgia, but on the basis of contacts with certain rock units and deep well samples from Florida, the age has been set as late Triassic. Contact metamorphism is seldom present, and then only slightly so; no mineral concentrations were found; and the dikes have little, if any, influence on the drainage patterns of the region."

GEOLOGY OF THE EASTERN VENEZUELA BASIN, Hollis D. Hedberg. **Geol. Soc. Am. Bull.**, v. 61, no. 11, p. 1173-1226, Nov. 1950. "The Eastern Venezuela Basin is a depression in the igneous-metamorphic rock basement filled with Mesozoic and Cenozoic sediments to a thickness of as much as 40,000 feet. The basin has a general east-west trend and is some 800 kilometers long and 250 kilometers broad . . . The region may be divided into physiographic provinces which in general reflect the areal distribution of formations and the regional geologic structure. These are the Northeastern Mountain, Northwestern Mountain, Foothills, Coastal Plains, Delta, Mesa (and Dissected Mesa), and Rolling Plains provinces. . . Each of the numerous individual formations . . . is described briefly with respect to name, type locality, areal distribution, lithology, thickness, surface expression, stratigraphic relations, environment of deposition, paleontology, age, and correlation, using both outcrop and well data available throughout the basin. The geologic history of the basin is outlined."

SPELEOLOGY

BONES IN THE BREWERY. George Gaylord Simpson. **Bull. 12**, Natl. Speleological Soc., p. 18-25, Nov. 1950. An interesting account of the discovery and excavation of fossil peccaries, an armadillo, and other Pleistocene animals in a cave in the heart of St. Louis (reprinted from **Natural History**). In the 1820's this cave was converted into a storeroom for lager beer, and a brewery was built above it. In the 1890's it was changed into an underground beer parlor. Another claim to fame came during prohibition when a large distillery was discovered in it. Lee Hess recently purchased the place with the idea of reopening it as a site of historical and geological interests. One of his workmen found the first bones while cleaning out a clay-filled passage. Cherokee Cave, at 13th & Cherokee Sts., is now open to the public.

CALCITE BUBBLES — A NEW CAVE FORMATION? Gordon T. Warwick, **Bull. 12**, Natl. Speleological Soc., p. 38-42, Nov. 1950. "Calcite deposited around air bubbles was found in rimstone pools in one of the limestone mines of Dudley Castle Hill, Worcestershire, England. A brief description is given of these mines together with a full description of the calcite bubbles and a report on the conditions under which they were found. To date no calcite bubbles have been reported from true caves, but it appears possible that the postulated conditions for their formation should be found in natural caverns."

FORMATION AND MINERALOGY OF STALACTITES AND STALAGMITES. Forrest L. Hicks. **Bull. 12**, Natl. Speleological Soc., p. 63-72. "Stalactites and stalagmites are shown to be formed from over sixty minerals and several other substances by a precipitation of the mineral, by solidifying from its liquid state, and by several less common means. Factors affecting their rate of growth, and their shape include the rate of incoming flow, rate of evaporation, chemical composition of the solution, and the size of the stalactite or stalagmite . . ."

ICE CAVES. Patricia Merriam. **Bull. 12**, Natl. Speleological Soc., p. 32-37, Nov. 1950. "Ice caves are permanent caves

in which ice forms and remains far into the summer or throughout the year. Several suggestions as to their origin are presented. The factors necessary for their formation are probably a rock formation with many crevices, cold winters, a good circulatory system and adequate shading in the summer. A list of ice caves in the U. S. is presented.

New Books

All books listed here are deposited in the Library of The Earth Science Institute and may be borrowed by the members. Books marked with an asterisk may be purchased through The Earth Science Publishing Co., Revere, Mass.

*SYMPHONY OF THE EARTH. J. H. F. Umbrove. 1950. xii, 220 p., 10 pls., 123 figs.; Guilders 11.00 ($2.90); cloth, Guilders 13.75 ($3.60); (Martinus Nijhoff, The Hague.)

Seven chapters, each constituting a subject in itself and adapted from one or more addresses or lecture, are presented "in more or less conventional prose" by the author of "The Pulse of the Earth": Symphonia terrestris; A country below sea-level; Across the Swiss Alps; Deep furrows on the continent and in the deep-sea; The root of a mountain-chain; A trip on a volcano; and Life and its evolution. The book closely follows the spoken word and the author has restricted the use of technical terms to a minimum so that the non-specialist will have little if any difficulty in understanding the text.

REPORT OF THE COMMITTEE ON THE MEASUREMENT OF GEOLOGIC TIME, 1949-1950. John P. Marble, Chairman. 1950. iv, 118 p. mimeographed; $1.00. (Div. of Geol. and Geog., Natl. Research Coun., Wash., D. C.).

In addition to the Chairman's summary report, the following papers are included: "Progress Report to the Committee on Measurement of Geologic Time", by P. M. Hurley; "Report to the Committee on Measurement of Geologic Time," by L. H. Ahrens; "Lead-Uranium Ratios of Two Saskatchewan Pitchblendes", by H. V. Ellsworth; "Review of Recent Work in Laboratory of Geophysics, Dept. of Geophysics, Univ. of Toronto", compiled by J. P. Marble; "Recent Analyses of Radioactive Minerals from Brazil", by Willer Florencio and Djalma Guimareas (collated, with comments, from the original paper by John P. Marble); "Annotated Bibliography of Articles Relating to the Measurement of Geologic Time", compiled by John P. Marble; and "Age in Years of the Formation of the Elements", by J. M. Lopez de Azcona (translated by John P. Marble).

OTHER PUBLICATIONS RECEIVED

GEOLOGY OF PART OF THE DELTA-MENDOTTA CANAL, NEAR TRACY, CALIFORNIA. Parry Reiche. 1950. 12 p., 5 figs.; $0.25 (Spec. Rpt. 2; Calif. Div. of Mines, San Francisco). The excavation exposed, for about 6 mi., Miocene & Plio-Plestiocene continental beds in a district of few natural outcrops. Engineering applications of the geology are discussed, in addition to the stratigraphy and structure.

LOESS FORMATIONS OF THE MISSISSIPPI VALLEY. Morris M. Leighton & H. B. Willman. 1950. 26 p., 2 pls., 9 figs.; free (Rpt. of Inv. 149; Ill. State G. S., Urbana). See **Earth Science Abstracts**, p. 24.

THE CHEYENNE SANDSTONE OF BARBER, COMANCHE, AND KIOWA COUNTIES, KANSAS, AS RAW MATERIAL FOR GLASS MANUFACTURE. Earl K. Nixon, Russell T. Runnels and Robert O. Kulstad. 1950. 44 p., 2 pls., 4 figs.; $0.10 (Bull. 86, Pt. 3; State G. S. of Kansas, Lawrence). Includes geology, petrography, and laboratory investigations of the sandstone.

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New Books

The following books were not listed in our complete catalog of books on the earth sciences, which appeared in the Earth Science Digest from June 1949 to January 1950.

THIS EARTH OF OURS by C. W. Wolfe. 1950. 384 pp., 239 figs.	$ 5.00
THE CAVE BOOK by Charles E. Hendrix. 1950. 68 pp., 34 figs.	1.00
STRUCTURAL PETROLOGY OF DEFORMED ROCKS by H. W. Fairbarn. 1949. 344 pp., 213 figs.	12.50
REBELLIOUS RIVER by J. P. Kemper. 1949. 279 pp., 7 figs.	6.00
APPLIED SEDIMENTATION edited by Parker D. Trask. 1950. 707 pp., 114 figs.	5.00
GRASSLAND HISTORICAL STUDIES by James C. Malin. Vol. I: Geology and Geography. 1950. 377 pp., 5 figs.	2.50
GEOCHEMISTRY by Kalervo Rankama and Th. G. Sahama. 1950. 912 pp., 50 figs.	15.00
INTRODUCTION TO THEORETICAL IGNEOUS PETROLOGY by Ernest E. Wahlstrom. 1950. 366 pp., 155 figs.	6.00
APPLIED HYDROLOGY by Ray K. Linsley Jr., Max A. Kohler, and Joseph L. H. Paulhus. 1949. 689 pp., 329 figs.	8.50
CRYSTALS AND X-RAYS by Kathleen Lonsdale. 1949. 199 pp., 13 pls., 138 figs.	3.75
GEOLOGY APPLIED TO SELENOLOGY — IV: THE SHRUNKEN MOON by J. E. Spurr. 1949. 207 pp., 36 figs.	4.00
A NEW THEORY OF HUMAN EVOLUTION by Sir Arthur Keith. 1949. 451 pp., 1 fig.	4.75
INTRODUCTION TO COLLEGE GEOLOGY by Chauncey D. Holmes. 1949. 429 pp., 312 figs.	4.00
THE ART OF THE LAPIDARY by Francis J. Sperisen. 1950. 382 pp., 1 pl., 406 figs.	6.50
GEOLOGY FOR ENGINEERS by Joseph M. Trefethen. 1949. 620 pp., 242 figs.	5.75
HYDROLOGY by C. O. Wisler and E. F. Brater. 1949. 419 pp., 132 figs.	6.00
NORTHWEST GEM TRAILS by H. C. Dake. 1950. 80 pp., 14 figs.	2.00

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